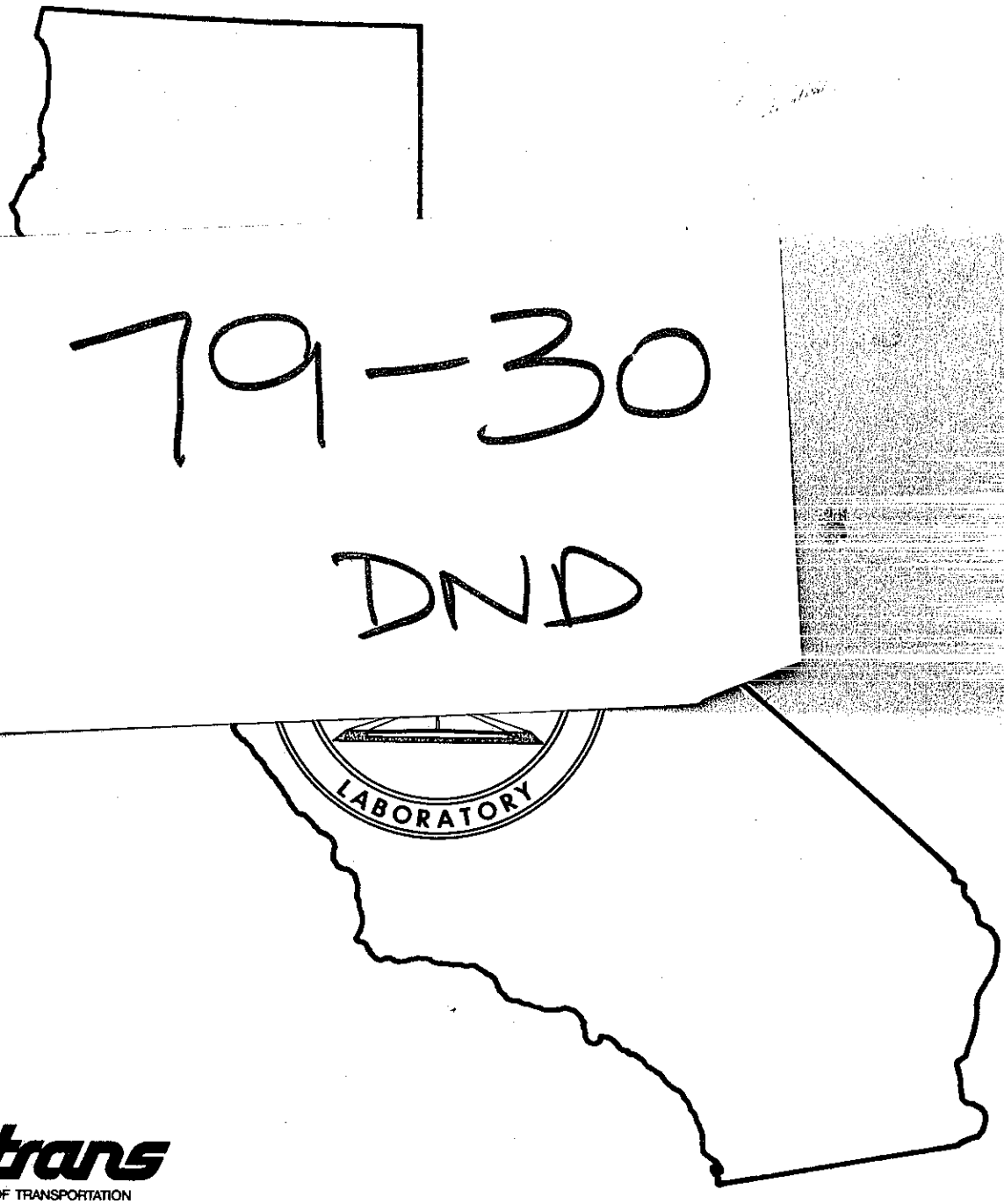
Ground Water Quality Study For The Richmond Semi-Depressed Section 04-CC-17



AUG. 1979

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF CONSTRUCTION
OFFICE OF TRANSPORTATION LABORATORY

04-CC-17, PM 1.3 to 3.9
47th St. to 6th St.
04209-108701
Lab Auth 652907
August 1979

Mr. T. R. Lammers - 04
District Director of Transportation

Attention: Mr. D. T. Cassinelli
District Materials Engineer

Gentlemen:

Submitted for your consideration:

SUPPLEMENT TO THE
REPORT
OF
GROUND WATER INVESTIGATION
FOR THE
PROPOSED

RICHMOND SEMI-DEPRESSED SECTION
04-CC-17
(GROUND WATER QUALITY STUDY)

Study made by . . . . . Soil Mechanics and Pavement Branch

Under the General Direction of . . . . Raymond A. Forsyth
Chief, Soil Mechanics and Pavement Branch

Work Supervised by . . . . . R. H. Prysock

Analysis and Report by . . . . . S. B. P. John
G. R. Winters
J. G. Macfarlane
L. R. Leech, Jr.

Very truly yours,

NEAL ANDERSEN
Chief, Office of Transportation Laboratory

By
Raymond A. Forsyth
Chief, Soil Mechanics and Pavement Branch

SBPJ:db
Attachment
Distribution I

TABLE OF CONTENTS

INTRODUCTION

This supplementary report has been prepared to complete the ground water quality study started as part of the ground water investigation for the project 04-CC-17, PM 1.3 to 1.9, 47th Street to 6th Street in Richmond. Initial ground water quality studies were presented in "Report of Ground Water Investigation for the Proposed Richmond Semi-Depressed Section 04-CC-17", dated September 1978.

Initially, it was planned to conduct a three-phase ground water sampling and testing program over a three month period. This was extended to a six-phase study, involving a total of seven months. The ground water sampling was done by TransLab personnel. The testing for Phase I was done by TransLab Chemistry Laboratory in Sacramento. Phases II through VI testing was done by the Sanitation and Radiation Laboratory of the Department of Health in Berkeley, California. The tests were conducted according to methods prescribed in the Federal Register.

Ground water samples were taken six times at monthly intervals over a period of seven months. A total of 2,229 tests of various kinds were conducted, as shown in Attachment 1. Detailed tabulations of various test data are presented in Attachments 2 through 36.

A few samples were found to contain higher than normal (or allowed) quantities of pollutants or contaminants. As the wells from which these samples were obtained were subject to contamination from surface sources during the period of sampling, the high values are not considered to be representative of the ground water now contained within the shallow aquifers. The dewatering operation should eliminate these conditions.

METHODS OF DISPOSAL

During construction it may be necessary to remove from 2.5 x 10^6 to 3.5 x 10^6 gallons of ground water per day. The duration of the construction period is estimated at between 2 and 2-1/2 years. During this period the total pumpage in some reaches of the project could be substantially lower than at the start of construction. After construction the total pumpage would be reduced to the order of 1 to 1.5 million gallons per day.

The ultimate disposal of the ground water discharge was a concern to District personnel responsible for the project's environmental document. TransLab was asked to address the feasibility of various disposal strategies. Methods of ground water disposal considered were:

1. development of a freshwater marsh
2. discharge into existing salt marsh(es)
3. highway landscape irrigation
4. direct discharge into San Francisco Bay
5. use for human consumption

Due to the diverse disposal methods considered and their possible impacts on the environment, a series of meetings with appropriate State Agencies was initiated. Since the proposed disposal methods could affect public health, wildlife and habitat, and the San Francisco Bay environment, the California Department of Health Services (DHS), Department of Fish and Game (DFG), and the California Regional Water Quality Control Board (CRWQCB) San Francisco Bay Region were contacted. Meetings were subsequently held with representatives from each department to obtain their response to various proposed methods for ground water disposal.

REVIEW CONFERENCES

Department of Health Services, Berkeley (DHS)

On March 20, 1979, a meeting was held with Department of Health Services representatives. Representing the DHS was Mr. Dick McMillan, DHS Supervising Sanitary Engineer, and Mr. Bob Hultquist, DHS Associate Sanitary Engineer in the Richmond area.

After a review of the Phase I-VI water quality test data (appended) and a discussion of the impacts expected on the shallow aquifers in the project corridor, Mr. McMillan concluded the water is not suitable for human consumption. In addition to the water quality test data, which indicated some contamination, Mr. McMillan felt the soil depth over the shallow aquifer (0-35'±) was not sufficient to ensure adequate filtration and natural purification processes. The shallowness of the aquifer precluded its use as a source for human consumption. (See References 2, 3 and 4.)

Mr. McMillan stated that there was no reason to preclude ground water from being used in highway landscape irrigation. After being informed that during part of the year roadway runoff will be mixed with the ground water for discharge from the project area, Mr. McMillan still felt that the water was suitable for highway right-of-way irrigation; but other uses, such as irrigation of parks, would require additional studies.

Mr. McMillan stated that the water might not be suitable for industrial utilization (e.g., Chevron of Richmond), because of relatively high total dissolved solids (TDS). This aspect of ground water utilization was not investigated

further because of the high TDS levels in the ground water as well as the additional contaminants expected from roadway runoff additions during the winter months.

It was noted that the Department of Health Service's responsibility did not extend to alternative disposal methods 1, 2, and 4.

California Regional Water Quality Control Board (CRWQCB), San Francisco Bay Region

On March 29, 1979, a meeting was held with representatives of the California Regional Water Quality Control Board, San Francisco Bay Region in Oakland. Attending for the CRWQCB were Messrs. Hobart C. Knapp and Richard K. McMurtry. These representatives were asked to evaluate the quantity and quality of ground water expected from the Hoffman project with respect to possible development of a freshwater marsh; discharge to an existing saltwater marsh; or direct discharge into San Francisco Bay via existing storm drains. (Alternatives 1, 2, and 4, Reference 5.)

Mr. Knapp outlined the Board's two main concerns in regard to the proposed Hoffman project:

° Possible effects of discharging freshwater into saline environments. Would discharge significantly affect the salinity of the receiving waters and result in adverse impacts to the aquatic environment?

° Protection of the aquifers underlying the project, particularly from saltwater intrusion.

EFFECTS OF FRESH GROUND WATER DISCHARGE

Various methods of fresh ground water discharge considered were as follows:

° Discharge into the Richmond Harbor Channel, or Inner Harbor Basin.

° Discharge across the Bay mud-flats via the existing Stege Drain near the U.C. Richmond Field Station.

° Development of a freshwater marsh using the ground water.

° Discharge into the existing Hoffman Salt Water Marsh.

Mr. McMurtry noted ground water disposal into Richmond Harbor would be acceptable provided the discharge is at a sufficient depth to ensure adequate dilution and no significant salinity changes.

Mr. McMurtry requested a field review of the Hoffman Marsh area, with representatives of the Department of Fish and Game (DFG) to evaluate the remaining methods.

Mr. McMurtry noted the CRWQCB would utilize the Department of Fish and Game's expertise in marsh biology to determine the advisability of allowing any of the proposed methods of discharge.

After a field review of the Hoffman Marsh area, Fish and Game representatives Messrs. Mike Rugg, Bob Huddleston, and Ted Wooster stated that DFG would oppose ground water discharge into the existing Hoffman Salt Water Marsh.

There was no objection to the discharge of the ground water directly into San Francisco Bay.

There was no objection to the discharge of ground water into a freshwater marsh if one existed.

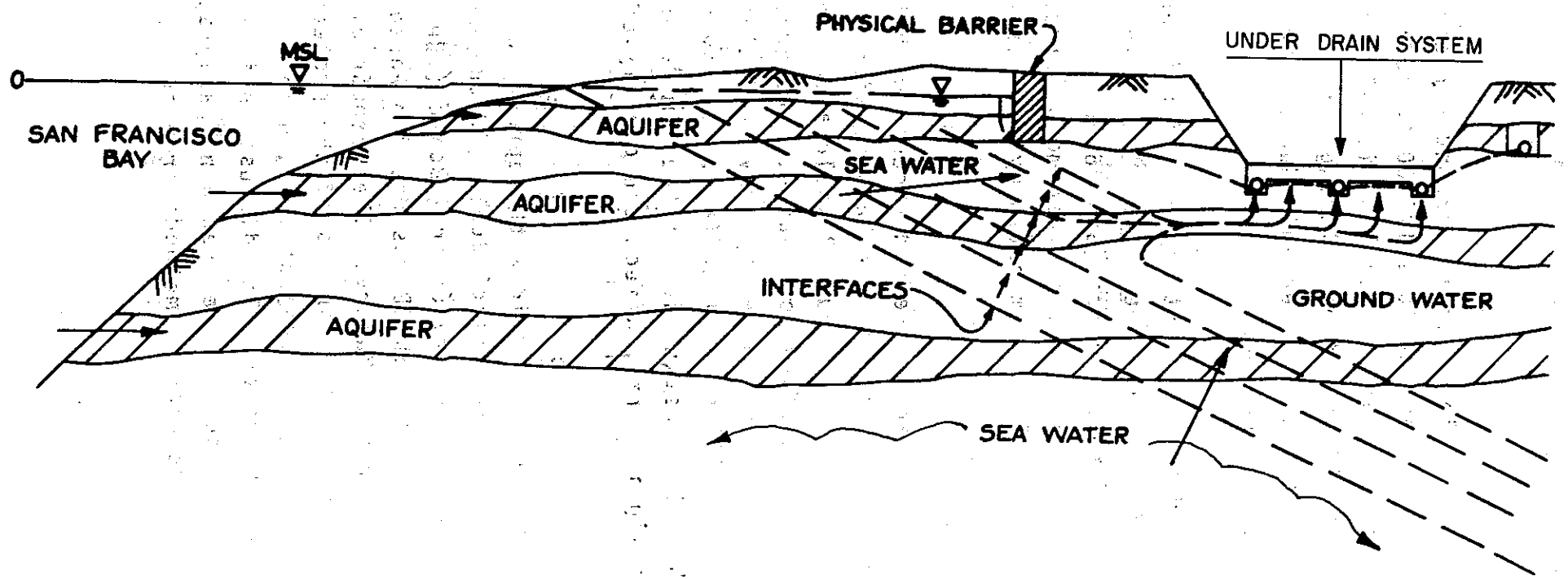
Both the CRWQCB and DFG stated that the discharge into Stege Drain would be acceptable and would result in no adverse effects on the creek or downstream tidal marshes and mud-flat environment.

PROTECTION OF THE AQUIFERS

A detailed literature survey was conducted to define the phrase "Richmond Aquifer" and was reported in Reference 1. The important finding in Reference 1 was that the phrase "Richmond Aquifer" was vaguely used in the existing literature. The aquifers underlying the project were found to vary not only in thickness and extent but also in depth and characteristics. Hence, names were suggested for these various aquifers as noted in Reference 1 and as presented as Figure 1 in this report. The aquifers within the top 35 feet were termed "Hoffman Aquifers". These are the aquifers which will be subject to excavation on the subject project. The average excavation limit will be in the top 20'± for most of the project and at the deepest portion it will be in the top 30'±. These shallow aquifers are subject to slow recharge and perched water table conditions.

The aquifers which extend generally from about 35' to about 125' were found to contain large amounts of water. These deeper aquifers are called "Richmond Aquifers" and will not be affected by the excavations for this project. These "Richmond Aquifers" should not be punctured due to any construction operations, including the subsurface drainage system.

The aquifers below 125'± are called "San Pablo Aquifers". The lower extent of these aquifers has not been well defined. It is expected to be much greater than 300'. Very little information is available on the geohydrologic characteristics of these aquifers. During the seawater intrusion study, it was postulated, based on the Ghyben Herzberg Theory, that the depth to interface between seawater and ground water



SEA WATER INTRUSION STUDY, RICHMOND SEMI-DEPRESSED SECTION
MODEL 4, LONG TERM EFFECTS OF A PHYSICAL BARRIER

FIGURE 2

From Ref. 1

Caltrans could induce some added seawater intrusion within the project area; which was, however, considered to be of no significant concern. The concensus was that there would be no damage to the aquifers in the Contra Costa Ground Water Basin as a result of the freeway construction. Mr. Richard McMurtry also suggested a monitoring system to evaluate the effects of the proposed construction. Mr. McMurtry noted no problems as far as SWRCB and CRWQCB are concerned and asserted he would confirm this decision by letter.

CONCLUSIONS

The discussions referred to above led to conclusions related to: (a) methods of disposal; (b) protection of the aquifers; and (c) a monitoring system. The conclusions are summarized for the first two subjects. The recommendations for the third section are presented in the end of this section.

Methods of Disposal

1. Discharge of the ground water to a freshwater marsh, (if one existed), would have been an acceptable disposal method as determined by the San Francisco Regional Water Quality Control Board. However, as the concept of developing a freshwater marsh as a mitigation measure is no longer under consideration, this method of disposal is discarded.

2. The San Francisco Bay Regional Water Quality Control Board acting on the advice of Department of Fish and Game representatives considers the discharge of ground water into the Hoffman Salt Water Marsh as unacceptable.

3. The California Department of Health Services representatives stated that the use of ground water for irrigation was acceptable only if the irrigation was limited to the highway right-of-way landscaping. Use of the ground water for other irrigation (e.g., irrigation of parks, etc.) would require further studies to assess its suitability.

4. The direct discharge of ground water into the San Francisco Bay was acceptable to the CRWQCB provided that any discharge into the Richmond Harbor would be at a depth sufficient to ensure adequate mixing and no significant salinity changes.

Discharge into the existing Stege Drainage Creek is considered acceptable by the CRWQCB.

5. Utilization of the ground water for human consumption was not acceptable to the California Department of Health Services.

Industrial use of the ground water was questionable.

Protection of the Aquifers

1. Standards for discharging ground water into the San Francisco Bay Waters will be provided by the San Francisco Regional Water Quality Control Board. It is anticipated that there will be no difficulty in meeting those standards.

2. The proposed physical barrier on the bayward side and the underdrain system should arrest any onward progress of seawater and limit it to the confines of the semi-depressed freeway section.

3. Since all the dewatering facilities are to be placed at relatively shallow depths (0-35'±), aquifers at depths below 35' in the Contra Costa Ground Water Basin (see Figure 1) will not be affected.

RECOMMENDATIONS

Monitoring System

1. Monitoring wells should be established on both sides of the depressed section to monitor any change in the quality of ground water.

2. The "Hoffman" and "Richmond Aquifers" should be monitored separately.

3. Spacing and depth of wells to the "Hoffman" and "Richmond Aquifers" will be decided by District 04 Materials personnel.

4. The quality of ground water in the "Richmond Aquifers" should be established prior to construction.

5. Any holes drilled into the "Richmond Aquifers" should be properly sealed or plugged to eliminate migration of ground water from one set of aquifers to another.

REFERENCES

1. John, S. B. P., Lee, A. Y., Leech, L. R., Campbell, J., and Macfarlane, J. G., "Report of Ground Water Investigation for the Proposed Richmond Semi-Depressed Section - 04-CC-17", Office of Transportation Laboratory, Sacramento, September 1978. (not attached with this supplement)

2. Water Quality Appraisal Meeting with Department of Health-Hoffman, Memorandum, G. A. Winters (TransLab) to File, March 26, 1979.

3. Ground Water Investigation - Richmond Semi-Depressed Section, Water Quality Study, Memorandum, S. B. P. John to R. A. Forsyth, April 9, 1979.

4. Ground Water Investigation - Richmond Semi-Depressed Section Water Quality Study, Memorandum, R. H. Hultquist (Sanitary Engineering Section-SFBD) to S. B. P. John (TransLab), June 20, 1979.

5. RWQCB Meeting on Hoffman Groundwater Quality, Memorandum, G. A. Winters (TransLab) to File, April 10, 1979.

6. Water Quality and Discharge of Ground Water from Depressed Section-Hoffman, Memorandum, S. M. Shadle (Caltrans) to File, April 12, 1979.

7. Dewatering Discharge from Hoffman Corridor Depressed Freeway Section, Memorandum, Richard K. McMurtry, (CRWQCB) to Sid Shadle, Caltrans, May 3, 1979.

8. Meeting with RWQCB and Technical Staff, Memorandum, T. J. Walsh (Caltrans) to File, May 25, 1979.

9. Memorandum, from Richard K. McMurtry, California Regional Water Quality Control Board, San Francisco Bay Region, to S. B. P. John (TransLab) dated July 26, 1979.

10. Memorandum, from Richard K. McMurtry, California Regional Water Quality Control Board, San Francisco Bay Region, to S. B. P. John (TransLab) dated July 31, 1979.

REFERENCE 2

State of California

Business and Transportation Agency

Memorandum

To : FILE

Date: March 26, 1979

File : 652907

From : **DEPARTMENT OF TRANSPORTATION**
Office of Transportation Laboratory

Subject: WQ Appraisal Meeting with Department of Health - Hoffman

On March 22, 1979 Gary Winters accompanied Bennett John (Geotechnical Branch) to a meeting with Department of Health Services (CDH) regarding groundwater quality from the Hoffman Corridor semi-depressed freeway in Richmond.

Attending the Meeting:

Dick McMillian, CDH Supervisor
Bob Hulquist, CDH District Engineer in the Richmond Area
Tom Walsh, District 04 Hydraulic Engineer
Richard Pence, District 04 Project Development, Project Eng.
Bennett John, TransLab's Geotechnical Branch
Bill Shoemaker, District 04 Environmental Planner
Gary Winters, TransLab's Enviro-Chemical Branch

Tom Walsh outlined the Hoffman project and the following questions about the suitability of the ±1 Mgd to be pumped from the aquifer.

1. Suitability for use in a freshwater marsh
2. Suitability for use in a saltwater marsh
3. Suitability for irrigation
4. Suitability for discharge into city storm drains and hence S.F. Bay
5. Suitability for human consumption

After reviewing the Phase I-VI water quality test results (attached), Mr. McMillian concluded the water was not suitable for human consumption (coliform the main concern). McMillian indicated their responsibility did not extend to some of the other uses. Bennett John and I will write a confirming letter to McMillian, to which he will respond in regards to the unsuitability of this water for human consumption.

Mr. McMillian pointed out that their responsibility does not extend to some of the other uses noted above. As a result, additional meetings with DFG and the SFRWRCB will be scheduled to gain similiar acknowledgements concerning the suitability of the groundwater pumpings.

Tom Walsh and Dick Pence noted roadway runoff will be mixed with the groundwater discharge. After a short discussion of TransLab's findings from the 657117 project Mr. McMillian felt the water would probably still be suitable for highway irrigation, i.e., from a health point of view but probably not suitable for industrial use (eg. sale to Chevron in Richmond who buys 0.8 Mgd from the East Bay Municipal Utility District.

Currently, Bennett John and Gary Winters are scheduling meetings with SFRWQCB (meeting March 29, 1979 in Oakland) and DFG (to be scheduled) to appraise them of the Phase I-VI water quality test data. They will be asked to consider the suitability of the discharged runoff/groundwater for the remaining uses outlined earlier.

After the meeting with McMillian I approached Tom Walsh about modifying the Walnut Creek site for the 657305 project. He indicated he was familiar with the site and felt modification would not be much of a problem. Walsh requested a letter to Jerry O'Shea - District 04 Engineering Services explaining the project and requesting the necessary modifications to the Walnut Creek site.

Gary R. Winters
Assoc. Environmental Planner

GRW:cj

cc: RHowell
RGilmore - HQ

REFERENCE 3

FND. SECT. FILE COPY JOB 652907

State of California

Business and Transportation Agency

Memorandum

8-432-4721 S.B.P.John

To : Mr. Raymond A. Forsyth
Chief, Geotechnical Branch

Date: April 9, 1979

File : 04-CC-17, P.M. 1.3/3.9
47th Street to 6th Street
04209 - 108701
Lab. Auth. #652907

From : **DEPARTMENT OF TRANSPORTATION**
Office of Transportation Laboratory

Subject: Groundwater Investigation of Richmond Semi-depressed Section Water Quality Study

On March 22, 1979, a meeting was held between regional public health engineers in the Department of Health, Berkeley, and representatives of District 04, as well as representatives from the Transportation Laboratory. The purpose of this meeting was to discuss the test data collected over a period of six months to determine the quality of the groundwater present within the shallow aquifers in the project area. These test data were generated to determine the potential uses of the groundwater in its present condition.

Those in attendance for the Department of Health included Dick MacMillan, Regional Engineer, and Bob Hultquist, District Engineer; Tom Walsh, Materials Engineer, Dick Pence, Project Engineer, Bill Shoemaker, Environmental Engineer, from District 04, CALTRANS; and Gary Winters and S. B. P. John from Headquarters Transportation Laboratory.

Mr. Walsh stated that the object of the meeting was to solicit the Department of Health for their opinion on how the groundwater from the Richmond semi-depressed section can be used. Mr. Walsh outlined the possible alternative uses of the groundwater:

1. Developing a freshwater marsh
2. Developing a saltwater marsh
3. For irrigation purposes
4. Disposal into San Francisco Bay, and
5. For human consumption

It was agreed at the suggestion of Dick MacMillan that the idea of saltwater marsh should be explored further with the Department of Fish and Game and that the idea of disposing of the groundwater in its present condition into San Francisco Bay be dealt with with the Regional Water Quality Control Board in Oakland. In its present condition, the groundwater in the shallow aquifers is not deemed fit for human consumption.

It was pointed out that after the semi-depressed freeway has been constructed, the surface runoff is likely to carry additional pollutants.

The waters "as is" can be used for irrigation on CALTRANS' landscape projects. The stormwaters during the winter may contain pollutants washed from the surface of the freeway which would not affect the usefulness for landscape irrigation purposes. Also, there may be no need for these waters for irrigation purposes during winter; therefore, alternate plans for disposal may have to be worked out.

S. B. P. John
Project Engineer

SBPJ:bh
cc R.MacMillan
T.Walsh
W.Schoemaker
G.Winters
R.Pence
R.Prysock

State of California
Department of Health Services

Memorandum

To : Department of Transportation
Office of Transportation Laboratory
Att: S. B. P. John
Project Engineer
5900 Folsom Blvd.
Sacramento, CA 95819

Date : June 20, 1979

Subject: Groundwater Investigation of Richmond Semi-depressed [illegible] Water Quality Study

From : Sanitary Engineering Section
San Francisco Bay District

This is in response to your request for comments on your memorandum of April 9, 1979 regarding the meeting of March 22, 1979. Your memorandum accurately represents the view of the Department of Health Services on the disposition of the groundwater.

R. H. Hultquist
Associate Sanitary Engineer

RHH:gm

REFERENCE 5

State of California

Business and Transportation Agency

Memorandum

To : MEMO TO FILE

Date: April 10, 1979

File :

From : **DEPARTMENT OF TRANSPORTATION**
Transportation Laboratory

Subject: RWQCB Meeting on Hoffman Groundwater Quality

On March 29, 1979 Gary Winters accompanied Bennet John (Geotechnical Branch) to a meeting with the Regional Water Quality Control Board (Region 2) in Oakland concerning the groundwater quality from the Hoffman Corridor semi-depressed freeway in Richmond.

Attending the meeting were:

H. C. (Chuck) Knapp-San Francisco Bay Region Water Quality Control Board (Region 2)
Richard R. McMutry - " " " " " "
Tom Walsh - Materials, Caltrans, 04
Dick Pence - Project Development, Caltrans 04
Sid Shadle - Env. Planning, Caltrans 04

The purpose of the meeting was to review the water quality data and establish the suitability of the groundwater for each of five disposal alternatives.

1. Discharge to a freshwater marsh
2. Flushing into existing salt marshes
3. Highway irrigation
4. Discharge into San Francisco Bay via existing storm drains
5. Human consumption

Tom Walsh briefly described the project and its groundwater problems and discussed the groundwater and water quality investigation undertaken by TransLab. Estimated water amounts vary from 2.5-3.5 mgpd during construction to 1 mgpd (±50%) during the operational phase. Walsh also summarizes our previous meeting with the Department of Health Services (re: file memo 3/26/79, G. R. Winters) in which the Department of Health Services deferred responsibility on all the above uses except irrigation and human consumption to the RWQCB and/or Dept. of Fish and Game (DFG). Dept. of Health felt that the water was suitable for State highway irrigation and not suitable for human consumption (domestic and industrial)

Chuck Knapp outlined the boards two basic concerns:

1. Protection of the Richmond aquifer, particularly from salt water intrusion. The board have their geologist in Sacramento, Al Franks, to review the TransLab groundwater report and its aquifer protection proposals.

2. The possible effects of discharging fresh water into the saline marshes, especially during the summer. Knapp questioned that such a discharge might significantly affect the salinity of the receiving waters and result in adverse impacts to the aquatic environment. Knapp said the board would expect Caltrans to resolve this question with the Department of Fish and Game.

The question of Bay disposal of the groundwater was discussed with McMurty who does not foresee a problem with direct disposal to the Bay if the disposal is made in a sufficient depth of water to insure adequate dilution and no salinity changes (i.e. Richmond Harbor Channel or Inner Harbor Basin). The disposal of the water across the mud flats via drainage channels, i.e., Stege Drain, would require more detail and study to evaluate its impacts.

McMurty requested a full review with Mike Rugg of DFG to answer the question of discharge to the salt water marsh. Chuck Knapp indicated the board should be able to provide their comments shortly after Al Frank's review of the TransLab study and the DFG field review.

Gary R. Winters
Associate Env. Planner

RECORD OF MEETING OR CONVERSATION

REFERENCE 6

Memorandum

FILE: 04209 - 108701 CC/Ala-I-180(17)

TO: FILES

FROM: SID M. SHADLE

WHERE HELD

☐ BY TELEPHONE ☐ DISTRICT OFFICE ☐ AT OTHER PARTY'S OFFICE ☒ OTHER Field Site

INITIATED BY

☒ DISTRICT ☐ OTHER PARTY ☐ OTHER

DATE OF CONVERSATION: 4/10/79

PARTICIPANTS

NAMES	TITLES & AFFILIATIONS
Richard McMurtry	Reg. Water Qual. Contr. Bd. (Reg. 2), Oakland (RWQCB)
Ted Wooster)	Calif. Dept. of Fish & Game (Reg. 3), Yountville (DFG)
Bob Huddleston)	
Mike Rugg)	
Joe Tieger	U.S. Fish & Wildlife Serv., Sacramento (USFWS)
Ken Wigglesworth	CALTRANS OEP, Sacramento
Dick Pence)	CALTRANS 04, Proj. Dev. A, San Francisco
Roy Yokoi)	
Sid Shadle	CALTRANS 04, Env. Plng. Bch., San Francisco

SUBJECT: Water quality and discharge of groundwater from depressed section. (Re: File memo 3/29/79, S. M. Shadle)

CALTRANS had requested comments from the RWQCB regarding five alternatives for disposing of groundwater from the proposed Hoffman depressed section. These choices, to be addressed in the water quality report being prepared by TransLab, are:

1. discharge to a freshwater marsh
2. flushing into existing salt marsh(es)
3. use for highway landscaping irrigation
4. direct discharge to S. F. Bay waters (via storm drain systems)
5. use for human consumption (domestic, industrial).

This review with DFG and USFWS was specifically requested by the RWQCB for the purpose of discussing the above alternatives and possible implications for natural ecosystems of the receiving waters.

We very briefly went through the 6-phase water quality data provided by TransLab. DFG commented that for the most part the water seemed "fresh." Wooster commented that the high coliform counts could indicate possible surface contamination of individual holes. Rugg noted that some data seemed particularly odd - possibly the result of uncased sample holes, poor sampling technique, or lab or recording errors. Specific parameters for which the data seems inconsistant include arsenic, lead, copper and sulphate (the latter can probably

be explained by the strata in the test holes). Wooster asked where the 1 mgpd was coming from, how were the acquifers recharged and what effect would our pumping have on the aquifers. Dick Pence explained that the aquifers were quite small and perched and recharge was very slow; thus the ±50% factor in the estimates.

I then recapped CALTRANS' mitigation and compensation proposals, stressing that we consider the efforts to rejuvenate Hoffman Marsh, improve tidal circulation and return portions of the S. P. levee to salt marsh to be appropriate compensation for the project's wetlands impacts. I added that we felt we had achieved basic agreement on those compensation concepts between USFWS, DFG, BCDC and ourselves.

I said that our current intention is to split the projected 1 mgpd (±50%) of groundwater to either end of the depressed section and discharge it to local storm drain systems (i.e.; Stege Drain near Bayview Avenue). If we encounter objections to discharge at this end (Bayview Avenue) we would probably pump all the water to the north end and discharge to the Richmond Harbor Channel. The five alternatives will be discussed in the supplemental water quality report but choices 1, 2 and 5 are not currently being contemplated.

Joe Tieger, said that USFWS agrees that compensation will be satisfied by our current proposals but he is still interested in creating a freshwater marsh. He wants to discuss the idea with various agencies and try to dig up the funds to purchase the necessary property. Dick Pence had asked R/W to develop some ball-park values for the land, which he provided to Tieger. Tieger said he would try to get some other government and public agencies together in a meeting sometime in the future to discuss his idea.

Dick McMurtry said that the RWQCB concerns centered around discharge across Bay mudflats or to tidal marshes. He agreed that our compensation seemed appropriate and said the Board would not expect a freshwater marsh unless necessary to effect treatment of the groundwater to satisfy DFG concerns.

Bob Huddleston said DFG favors improvement of tidal circulation in Hoffman Marsh but definitely would not want the groundwater discharged directly to the tidal marsh. Neither Rugg nor Wooster see any problem in discharging directly to the Bay or a freshwater marsh, if one existed. I noted that we could probably arrange to supply the pumped water to a freshwater marsh if one were created by others. Bob Huddleston asked what would be involved in pumping the entire 1 mgpd to the south end in such a case.

We walked along the SP levee and along Stege Drain downstream of the existing highway. All participants agreed that direct discharge into Stege Drain would not have any adverse effects on the creek or downstream tidal marshes and mudflats. Tieger asked if we could deposit the spoils from breaching the SP levee onto the resulting island to create some topograhic relief. This seems like a good idea and would solve the problem of a disposal site for the material.

Dick McMurtry said the Board would provide us with a letter addressing our five questions as soon as possible. They have only to receive the comments from their staff geologist on our proposals to prevent salt water intrusion before they respond.

I told all the participants that CALTRANS would contact them again when we reach the project design stage (possibly several years in the future) for assistance in developing the details of the marsh rejuvenation.

Sid Shadle

SID M. SHADLE
District Naturalist

SMS:em

cc: RHJ-RWO-JWR-SMS, ROF-WRS, RDG-REF-RDP, TJW, K. Wigglesworth (OEP), G. Winters-B. John (TransLab), R. K. McMurtry (RWQCB, Reg. 2), T. Wooster (DFG, Reg. 3), M. Rugg (DFG, Reg. 3), B. Huddleston (DFG, Reg. 3), J. Tieger (USFWS)

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
1111 JACKSON STREET, ROOM 6040
OAKLAND 94607

Phone: Area Code 415
464-1255

May 3, 1979

File No. 2119.00 (RKM) vjw

Mr. Sid Shadle
Environmental Planning Branch
CALTRANS
P. O. Box 3366
San Francisco, CA 94119

Dear Mr. Shadle:

Subject: Dewatering Discharge from Hoffman Corridor
Depressed Freeway Section

Based on our field inspection of the proposed discharge sites, review of the raw monitoring data, and conversations with Department of Fish and Game staff, I believe the location of your proposed dewatering discharge, either to the adjacent storm drain or to the proposed freshwater marsh, would not impair beneficial uses of the receiving waters.

Attached are the standard heavy metals limits for discharge to Bay waters. Please let us know if you anticipate any difficulty in meeting these limits.

The remaining issue to be resolved is the adequacy of your proposal to prevent salt water intrusion in the aquifers underlying the depressed section. We will be able to meet with you to discuss this aspect of the project in early May after reviewing comments prepared by the Technical Support Branch of the State Water Resources Control Board.

Sincerely,

Richard K McMurtry

RICHARD K. MCMURTURY
Water Resources Control Engineer

Attachment:
Heavy Metal Limits

cc: Mike Rugg, Department of Fish and Game, Yountville

Memorandum

To : Files

Date: May 25, 1979

File : 04-CC-17(180)-Rch
47th St. to Marine St.
04209 - 108701
Semi-Depressed Profile Study

From : DEPARTMENT OF TRANSPORTATION - 04
T. J. Walsh

Subject: MEETING OF MAY 17, 1979 WITH RWQCB AND TECHNICAL STAFF

Background

Several meetings with other State Agencies had been held with respect to disposal of ground water discharge from the proposed semi-depressed freeway profile through Richmond.

Certain issues previously had been resolved.

The purpose of this meeting was to discuss the following:

* Protection of the "Richmond Aquifer"

* Effects of discharging fresh water into salt water environments.

Meeting of May 17, 1979

The subject meeting was held in the Sacramento Office of the State Water Resources Control Board and lasted, uninterrupted, for approximately three hours (0930 - 1230).

Those in attendance were:

J. M. Parsons	-	State Water Resources Control Board
R. McMurtry	-	RWQCB (Oakland Office)
R. H. Prysock	-	HQs Trans-Lab
S. B. P. John	-	HQs Trans-Lab
R. D. Pence	-	District 04 - Proj.Dev. A
D. G. Heyes	-	District 04 - Materials
T. J. Walsh	-	District 04 - Hydraulics.

Mr. Walsh moderated the meeting and lead it off by reciting the history of the project over the past 25+ years; noting the various concepts considered and studied, i.e.:

* A rolling grade line - carried at ground level and rising over cross-street interchanges.

* An elevated profile - primarily on embankment.

* A fully depressed profile - 25 to 30 feet below ground level.

* A fully elevated profile - largely on structure.

* The current semi-depressed profile - nominal depth 10 to 15 feet below ground level; maximum localized depth 26 feet.

The several foundation investigations performed were covered in some detail, i.e.:

* The exploration for embankment construction which was made in the latter 1950's and early 1960's.

* The exploration for a fully depressed profile which was done in 1971-72. Discussion covered number and types of borings; number, extent and depth of pumping tests.

* The exploration for a semi-depressed profile which was conducted in 1977-78. The number and types of borings together with the detail of pumping, recovery, and drawdown tests were presented and discussed.

* The extent of data searching from both public and private sources was recited.

In the ensuing discussion, a number of specific items were covered, with agreements and conclusions as noted below:

* Following the historical resume' and detail of exploration, Mr. Parsons evidenced satisfaction with the various pumping tests.

* Transmissibility values used were considered acceptable.

* The concept of a physical ground water barrier on the bayward side was acceptable.

The possible occasion of "windows" in the aquicludes was discussed.

The linear extent of the barrier was agreed on at approximately Stations 200 to 260.

Leakage around the barrier was of no concern.

* It was concluded that "deeper aquifers" would not be affected. (Specifically those below a depth of 30 to 35 feet.)

* It was concluded that, with appropriate control, discharge to the bay through either the Stage drain or into the Richmond Harbor would be acceptable.

* Observation wells to both shallower and deeper aquifers will be incorporated. Spacing will be decided at a later date.

* Water quality will be monitored after construction. Contingency plans will be developed should unacceptable contamination be detected.

* Mr. McMurtry will prepare a set of water quality standards for discharge into the bay.

At the conclusion of the meeting both Mr. McMurtry and Mr. Parsons expressed satisfaction with the Caltrans report and with the Richmond project.

Mr. Parsons will prepare a re-evaluation for Mr. McMurtry.

After receipt of Mr. Parsons' comments, Mr. McMurtry will prepare a memorandum with the concurrence for Caltrans.

T. J. Walsh

T. J. WALSH
District Hydraulics Engineer

TJW:ah
cc: RHPrysock
SBPJohn
RDPence
JO'Shea-DTCassinelli(2)
RAForsyth
TJWalsh

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
1111 JACKSON STREET, ROOM 6040
OAKLAND 94607

Phone: Area Code 415
464-1255

July 26, 1979

File No. 2118.04 (RKM) aj

Mr. Bennett John
Department of Transportation
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, CA 95819

Dear Mr. John:

Subject: Proposed Hoffman Freeway, Richmond, Contra Costa County

With respect to the subject project, I concur with the attached comments prepared by Mr. James Parsons of the State Water Resources Control Board staff. I see no problem with discharge of dewatering waters to either the Stege drain or a man-made fresh water marsh as proposed, provided the water quality limits listed in attachment B are met. Also, the proposed saltwater intrusion barrier appears adequate to prevent saltwater intrusion along most of the freeway depressed section. I do not consider continued intrusion in the small area between the Richmond Harbor and the west end of the freeway project to be significant, especially since there are no known beneficial uses of the area's shallow aquifers and the area already has evidence of intrusion.

Prior to final approval of plans and specifications, CALTRANS should submit to this office detailed plans of the dewatering and discharge facilities. Also, prior to construction, you should establish the ground watering monitoring wells specified in attachment A.

An NPDES Permit will be necessary for regulation of waste discharge during and following construction. This would set effluent limits on the dewatering discharge and regulate or prohibit the discharge of contaiminated stormwaters or other construction related wastes. Your application should be submitted 6 months prior to construction and should include a detailed description of erosion control measures during construction.

Sincerely,

Richard K. McMurtry

RICHARD K. McMURTRY
Water Resources Control Engineer

Attachments (2)

A. Memo from Jim Parsons
B. List of NPDES Requirements

cc: List attached

cc: w/attachments

Sid Shadle
CALTRANS
P. O. Box 3366
San Francisco, CA 94119

Mike Rugg
Department of Fish and Game
P. O. Box 47
Yountville, CA

STATE WATER RESOURCES CONTROL BOARD

Attachment A

INTERNAL MEMO

In Reply Refer To: 415/JMP

TO: Dick McMurtry

San Francisco Bay Regional Board

DATE:

FROM: Jim Parsons

DIVISION OF PLANNING AND RESEARCH

SIGNATURE: Jim

SUBJECT: Proposed Hoffman Freeway, Richmond, Contra Costa County

We met with representatives of the California Transportation Agency (see attached attendance list) at my office May 17, 1979, to discuss some of the potential water quality threats posed by the semi-depressed section near Richmond Harbor. In addition to my April 17, 1979, memorandum to you, I also prepared a list of discussion points (copy attached) prior to the meeting.

Findings:

1. Although there was only a fleeting reference to earlier pump tests in the September 1978 CalTrans report, the CalTrans' engineers also had available data from earlier full-fledged pump tests and 10 single-hole recovery tests to prepare estimates on the expected range of permeability values to be encountered at the project.

2. Since the September 1978 report, there have been a substantial number of additional groundwater samples taken and submitted for a broad spectrum of analyses. Results will soon be available.

Conclusions:

1. The methods used by the CalTrans' engineers to obtain permeability values for the shallow aquifers for estimation of dewatering quantities, settlement, etc., are reasonable.

2. The dewatering methods proposed by CalTrans probably will not cause serious water quality problems.

   a. There will be induced seawater intrusion within a small area between Richmond Harbor and the west end of the freeway project. There are, however, no known beneficial uses of the shallow groundwater in this area.

1979

SWRCB 326 (3-75)

rname Parsons 5/23/79

b. It is quite possible that leaks in the cap over the deeper aquifers will be encountered during the freeway construction. If nothing is done, inflows from these "breakthroughs" will necessitate handling much larger quantities of water than expected and, in addition, lead to water quality problems. However, this situation will also seriously impede construction progress. Thus, CalTrans will have ample incentive to "plug leaks" as rapidly as possible. Methods available to them might include freezing of the soil, grouting to reduce the permeability, placement of a clay blanket, etc.

3. Until the results of the recent analyses of groundwater are available, we cannot evaluate the impacts that the water removed by the dewatering facilities will have at the points of disposal. It does seem likely that the reported high coliform concentrations described in the August 1978 report were the result of contamination at the well rather than being representative of the water now contained in the shallow aquifers.

4. Since all dewatering facilities are to be placed at relatively shallow depths, there cannot be a serious "drying up" of the Richmond groundwater basin as a result of CalTrans' plans.

Recommendations:

Prepare waste discharge requirements for this project that contain:

1. Limits on the specific constituents in the water to be discharged to the bay that could cause adverse effects.

2. Submittal of the detailed plans of the dewatering facilities prior to start of construction.

3. Establishment of monitoring wells on the landward side of the freeway semi-depressed section at a minimum of 2,000-foot centers between Freeway Stations 172+00 to 220+00; minimum of 1,000-foot centers between Stations 220+00 and 250+00; and minimum of 750-foot centers from Station 250+00 to 280+00.

4. Require CalTrans to contact the Regional Board at any time that inflows to the excavation and quantities of water removed by the dewatering facilities exceed that expected by more than 50 percent.

Attachments - 2

Attachment B

List of Probable NPDES Requirements:

			Average	Max	
1.	Suspended Solids	mg/l	30	60	
2.	Oil and Grease	mg/l	10	20	
3.	Settleable Matter	ml/l	.1	.2	
4.	pH				6.0 <pH<9.0
5.	Toxicity				90% survival (3 sample median)
6.	Coliform MPN/100ml				240 (5 sample median) 10,000 (verifiable max.)
7.	NH_4OH mg/l				.025 mg/l annual median .4 mg/l max.
8.	Metals and Toxicants				Concentration not to be exceeded more than:

	Unit of Measurement	50% of time	10% of time
Arsenic	mg/l	0.01	0.02
Cadmium	mg/l	0.02	0.03
Total Chromium	mg/l	0.005	0.01
Copper	mg/l	0.2	0.3
Lead	mg/l	0.1	0.2
Mercury	mg/l	0.001	0.002
Nickel	mg/	0.1	0.2
Silver	mg/l	0.02	0.04
Zinc	mg/l	0.3	0.5
Cyanide	mg/l	0.1	0.2

Note: These limits would apply to the dry weather discharge. Modifications to certain parameters may be appropriate during wet weather. CALTRANS' application for NPDES permit should include an estimate of anticipated water quality during both dry and wet weather.

REFERENCE 10

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
1111 JACKSON STREET, ROOM 6040
OAKLAND 94607

Phone: Area Code 415
464-1255

July 31, 1979

File No.: 2118.04 (RKM)aj

Mr. Bennett John
Department of Transportation
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, CA 95819

Dear Mr. John:

Though not stated in my letter of 23 July, my statement that an NPDES permit could be issued with the suggested limits is informal staff opinion only; issuance of a permit would be subject to both interagency review and our Board review which conceivably could result in modification of proposed limits or conditions of discharge.

Sincerely,

Richard K. McMurtry

RICHARD K. McMURTRY
Water Resources Control Engineer

ATTACHMENTS

RICHMOND SEMI-DEPRESSED SECTION

ATTACH. 1

WATER QUALITY TESTS — TOTALS

Item	Phase I	Phase II	Phase III	Phase IV	Phase V	Phase VI	Others *	Sub-Total
Atrazine	—	—	—	1	—	—	—	1
Endrin	9	—	17	12	—	—	—	38
Lindane	9	—	17	12	—	—	—	38
Methoxychlor	9	—	17	12	—	—	—	38
Toxaphene	9	—	17	12	—	—	—	38
2,4-D	9	—	17	12	—	—	—	38
2,4,5-TP Silvex	9	—	17	12	—	—	—	38
pH	9	10	17	16	17	17	17	103
TDS	9	10	15	16	17	17	—	84
Conductivity	9	10	16	16	17	17	—	85
Chloride	9	10	17	16	17	17	17	103
Sulfate	9	10	17	16	17	17	17	103
Arsenic	—	10	17	16	17	17	—	77
Barium	—	10	16	16	17	17	—	76
Cadmium	—	10	17	16	17	17	—	77
Chromium	—	10	17	16	17	17	—	77
Lead	—	10	16	16	17	17	—	76
Mercury	9	10	15	16	17	17	—	84
Nitrate	9	10	17	16	17	17	4	90
Selenium	—	10	17	16	17	17	—	77
Silver	—	10	17	16	17	17	—	77
Coliform	9	10	17	16	17	17	—	86
Fecal Coliform	—	10	3	1	17	17	—	48

5/15/79
JGM

RICHMOND SEMI-DEPRESSED SECTION

ATTACH. 1

WATER QUALITY TESTS — TOTALS

Item	Phase I	Phase II	Phase III	Phase IV	Phase V	Phase VI	others *	Sub-Total
Magnesium	9	—	—	16	16	17	—	58
Calcium	9	—	—	16	16	17	—	58
Bicarbonate	9	10	—	16	17	17	4	~~69~~ 73
Potassium	—	—	—	16	17	17	—	50
Fluoride	—	10	—	16	17	17	—	60
Iron	9	—	16	16	17	17	—	75
Sodium	9	—	—	16	17	17	—	59
Zinc	9	—	17	16	17	17	—	76
Manganese	9	—	16	16	17	17	—	75
Copper	9	—	17	16	17	17	—	76
Resistivity	—	—	—	—	—	—	17	17
Totals	198	180	419	474	440	442	76	2229

* Pre-Phase I tests

5/15/79
JGM

ATTACHMENT 2

ARSENIC — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1	✓	✓	.016	.033	0.005	0.008	
R-2		✓	<.001	.002	<.001	0.002	
R-2A		✓	<.0025	<.001	0.0025	0.002	
P-12		✓	0.52 ?	.004	<.001	0.006	
P-11		.002	.004	——	0.040	0.003	
D-17		.004	.004	.005	0.016	0.009	
D-16		.002	.003	.003	0.100	0.007	
P-10		.002	.002	.002	0.003	.006	
P-9		.002	.005	.005	0.002	.005	
R-3		✓	.007	<.001	0.002	.003	
P-7		.001	.002	.001	<.001	.003	
P-6		.001	.003	.002	<.001	0.005	
P-4		.001	.001	.002	<.001	<.001	
P-2		.001	.003	.001	0.004	0.004	
R-4			<.001	.01	0.007	0.02	
P-13		.001	.002	.001	0.001	0.002	
R-5			.005	<.001	<.001	0.002	

ATTACHMENT 3.

BARIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<0.1	<0.1	<0.1	0.066	
R-2			0.18	<0.1	<0.1	0.089	
R-2A			.042	<0.1	<0.1	0.069	
P-12			1.0	0.1	0.10	0.12	
P-11		0.36	*		0.60	0.12	* Insufficient sample
D-17		0.76	0.11	0.1	0.30	0.14	
D-16		0.23	0.11	<0.1	0.90	0.097	
P-10		0.24	0.11	0.1	<0.1	0.40	
P-9		0.57	0.13	0.1	0.15	0.055	
R-3			0.80	<0.1	<0.1	0.057	
P-7		0.12	0.15	<0.1	<0.1	0.067	
P-6		0.17	0.21	0.1	0.10	0.14	
P-4		0.24	0.11	<0.1	<0.1	0.09	
P-2		0.29	0.15	0.1	0.15	0.31	
R-4			0.24	<0.1	0.12	0.033	
P-13		0.28	0.20	<0.1	<0.1	0.067	
R-5			0.14	<0.1	<0.1	0.045	

ATTACHMENT 4

CADMIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.05	.002	0.002	0.001	SYNERGISTIC W/ ZINC — .03 CD + .15 ZN TOXIC TO SALMON FRY.
R-2			<.05	<.001	0.001	0.002	
R-2A			<.001	.038	<.001	<.001	
P-12			<.001	<.001	0.002	<.001	
P-11		.0002	<.05		0.004	0.003	
D-17		.002	.002	.001	0.002	0.002	
D-16		.0007	<.05	.001	<.001	0.009	
P-10		.0002	<0.05	.012	0.003	<.001	
P-9		.0009	<0.05	.05	<.001	<.001	
R-3			<0.05	<.001	<.001	0.002	
P-7		.0002	<0.05	<.001	0.001	0.003	
P-6		.0002	<0.05	<.001	0.003	<.001	
P-4		.0002	<0.05	.001	<.001	<.001	
P-2		.0005	<0.05	.001	<.001	0.001	
R-4			<0.05	<.001	0.004	<.001	
P-13		.006	<0.05	<.001	0.001	<.001	
R-5			<0.05	<.001	0.001	<.001	

ATTACHMENT 5

CHROMIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			.004	<.005	0.006	0.033	
R-2			<.001	<.005	0.007	0.005	
R-2A			.001	.005	0.015	0.005	
P-12			.072	.005	0.008	0.008	
P-11		<.02	<.04		0.600	0.008	
D-17		<.02	<.04	.007	0.058	0.015	
D-16		<.02	0.023	0.01	0.260	0.011	
P-10		<.02	.013	<.005	0.007	0.008	
P-9		<.02	.027	0.03	0.020	0.005	
R-3			<.04	<.005	<.005	0.004	
P-7		<.02	.010	<.005	0.005	0.003	
P-6		<.02	.014	<.005	<.005	0.007	
P-4		.02	.090	.025	0.012	0.112	
P-2		<.02	.027	<.005	0.005	0.011	
R-4			<.04	.006	0.034	0.017	
P-13		<.02	.017	<.005	0.010	0.002	
R-5			.012	.005	0.005	0.003	

ATTACHMENT 6

LEAD — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			.010	0.024	0.010	0.072	
R-2			.002	0.010	0.007	0.323	
R-2A			.003	0.004	0.016	0.019	
P-12			.280	0.13	0.016	0.041	
P-11		.026	—		1.400	0.020	
D-17		.068	.006	0.018	0.050	0.057	
D-16		.025	.025	0.022	0.012	0.039	
P-10		.005	.036	0.07	0.080	0.033	
P-9		.004	.030	0.02	0.060	0.023	
R-3			.090	0.008	0.005	0.025	
P-7		.006	.020	0.012	0.020	0.012	
P-6		.003	.050	.011	0.005	0.021	
P-4		.006	.420	0.013	<.005	0.006	
P-2		.005	.038	0.005	0.005	0.041	
R-4			<.004	0.007	0.005	0.050	
P-13		.008	.040	0.005	0.007	<.005	
R-5			.068	<.001	0.005	0.020	
							MAX. CONTAMINANT LEVEL = 0.05

ATTACHMENT 7

MERCURY – MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			.001	.0009	.0008	0.0004	
R-2			.0005	.0016	<.0001	.0004	
R-2A			.0003	.0006	<.0001	.0002	
P-12			*	.0002	.0005	.0003	* Insufficient sample
P-11	<.0002	.0002	—		.0010	.0001	
D-17		.0004	<.0001	.0003	.0003	<.0001	
D-16	<.0002	.0002	<.0001	.0003	.0004	.0001	
P-10	<.0002	.0002	.0003	<.0001	.0002	.0002	
P-9	<.0002	<.0001	<.0001	.0001	.0003	<.0001	
R-3			<.0001	.0003	<.0001	.0002	
P-7	<.0002	.0003	.0001	.0002	<.0001	.0005	
P-6	<.0002	<.0001	<.0001	.0001	.0003	.0002	
P-4	<.0002	<.0001	<.0001	.0002	.0002	.0002	
P-2	<.0002	<.0001	.0001	.0002	.0004	.0001	
R-4			<.0001	.0016	.0007	.0008	
P-13	.0002	.0002	.0012	.0002	.0001	.0006	
R-5			.0002	.0003	<.0001	.0004	
							MAX. CONTAMINANT LEVEL = 0.002

ATTACHMENT 8

NITROGEN – MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1	Nitrate (N x 4.43)	Nitrate (N x 4.43)	<0.1	0.3	0.3	1.7	SEE NITRATE FOR STANDARD
R-2			3.1	4.4	5.2	6.4	
R-2A			3.3	2.9	3.0	1.6	
P-12			<.002	11.8	10.6	8.9	
P-11	19	5.3	2.8		3.1	0.3	
D-17		5.8	.001	0.6	1.2	0.7	
D-16	28	24	3.5	5.9	5.6	6.7	
P-10	24	21	4.2	5.6	4.9	3.7	
P-9	32	26	6.3	6.6	6.2	3.4	
R-3			0.1	0.1	0.2	1.8	
P-7	18	11	<0.1	2.6	2.0	7.0	
P-6	27	23	5.6	5.7	5.1	1.6	
P-4	24	22	4.8	5.9	5.2	11.6	
P-2	41	28	7.5	8.1	8.0	8.8	
R-4			<0.1	0.2	0.3	1.2	
P-13	46	48	8.0	10.4	8.6	8.6	
R-5			<0.1	0.5	0.7	2.4	

ATTACHMENT 9

NITRATE — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<0.44	5.8	5.8	7.5	
R-2			14	19	23	28	
R-2A			15	13	13	7.1	
P-12			<.009?	52	47	39	
P-11	19	5.3	12	—	14	1.3	
D-17		5.8	.004	2.7	5.3	3.1	
D-16	28	24	16	26	25	30	
P-10	24	21	19	25	22	16	
P-9	32	26	28	29	27	15	
R-3			0.44	0.44	0.89	8.0	
P-7	18	11	<.44	12	8.9	31	
P-6	27	23	25	25	23	7.1	
P-4	24	22	21	26	23	51	
P-2	41	28	33	36	35	40	
R-4			<.44	0.89	1.3	5.3	
P-13	46	48	35	46	38	38	
R-5			<.44	2.2	3.1	11	

ATTACHMENT 10

SELENIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			.012	<.001	0.006	<.002	
R-2			<.001	<.001	<.001	<.005	
R-2A			<.001	<.001	<.001	0.002	
P-12			<.002	<.001	<.001	<.002	
P-11		.001	<.001		0.010	<.002	
D-17		.003	.001	<.001	<.001	<.002	
D-16		.001	<.001	<.001	<.001	<.002	
P-10		.003	<.001	<.001	<.001	0.004	
P-9		.003	<.001	.001	<.001	<.002	
R-3			<.001	<.001	<.001	<.002	
P-7		.002	.004	<.001	<.001	<.002	
P-6		.002	<.001	<.001	<.001	<.002	
P-4		.001	<.001	<.001	<.001	<.002	
P-2		.003	<.001	<.001	<.001	<.002	
R-4			.002	.010	<.001	0.009	
P-13		.003	<.001	<.001	<.001	<.002	
R-5			<.001	<.001	<.001	<.002	

ATTACHMENT 11

SILVER — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.005	<0.010	<.001	<.001	
R-2			<.10	<0.001	<.001	<.001	
R-2A			<.10	<0.001	<.001	<.001	
P-12			.002	<0.001	<.001	<.001	
P-11		<0.01	<.1	DRY	0.002	<.001	
D-17		<0.01	<.005	<0.001	<.001	<.001	
D-16		<0.01	<.1	<0.001	0.001	<.001	
P-10		<0.01	<0.10	0.028	0.001	<.001	
P-9		<0.01	<0.10	<0.001	<.001	<.001	
R-3			<0.10	<0.001	<.001	<.001	
P-7		<0.01	<0.10	<0.001	<.001	<.001	
P-6		<0.01	<0.10	<.001	<.001	<.001	
P-4		<0.01	<0.10	<0.001	0.001	<.001	
P-2		<0.01	<0.10	<0.001	<.001	<.001	
R-4			<0.10	<0.001	0.001	<.001	
P-13		<0.01	<0.10	<0.001	0.001	0.001	
R-5			<0.10	<.001	<.001	<.001	

ATTACHMENT 12

TOTAL DISSOLVED SOLIDS – MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			22188	27860	27620	3520 ?	
R-2			593	415	536	484	
R-2A			323	356	307	322	
P-12			694	527	530	551	
P-11	396	443	*	DRY	444	425	* Insuff sample
D-17	✓	359	311	298	323	575	
D-16	445	475	762	421	428	340	
P-10	417	451	412	355	345	514	
P-9	845	816	774	739	725	400	
R-3	✓		315	312	282	308	
P-7	312	345	301	321	319	320	
P-6	524	536	457	469	460	532	
P-4	383	403	348	302	359	680	
P-2	643	630	566	624	586	548	
R-4	✓		—	29405	29155	21720	
P-13	804	906	773	938	855	680	
R-5			550	509	559	360	

ATTACHMENT 13

CONDUCTIVITY — μMHO/CM

BORING	PHASE I FIELD / LAB	PHASE II FIELD / LAB	PHASE III FIELD / LAB	PHASE IV / LAB	PHASE V	PHASE VI	REMARKS
R-1			1157*/38220	42100	41100	5820 ?	
R-2			994*/1000	742	1080	744	
R-2A			905*/586	570	690	530	
P-12			809*/975	941	981	894	
P-11	668/680	*420/700	L**		770	624	* Martek V shield not removed
D-17	"	*455/580	544/593	598	643	576	** Insuff. sample
D-16	726/740	*445/720	800/762	771	840	482	
P-10	741/740	*444/720	763/718	721	700	752	
P-9	005/1370	*433/1310	1337/1362	1390	1210	465	
R-3	"		688/630	610	582	390	
P-7	553/530	*338/535	612/570	570	506	378	
P-6	914/900	*362/830	891/817	872	862	686	
P-4	659/670	*411/640	722/666	620	719	594	
P-2	1086/1060	*415/1020	1106/1080	1065	1139	793	
R-4			— /4280	44400	46180	32500	
P-13	1449/1330	*408/1410	1112/1740	1500	800	1080	
R-5			1090/1041	939	1020	467	

ATTACHMENT 14

CHLORIDE LEVELS = MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			11903	17521	15803	1830 ?	4000 MG/L MAX. FOR BASS, PIKE & PERCH 400 MG/L MAX. FOR TROUT
R-2			93.1	66.4	91.8	64.2	
R-2A			75.3	73.6	67.8	50.5	
P-12			90.7	91.6	92.4	77.0	
P-11	60	72	95.2	DRY	101.9	70.9	
D-17		52	55.2	63.9	60.0	53.8	
D-16	65	74	83.5	94.7	92.4	72.7	
P-10	67	64	71.9	78.3	75.0	56.2	
P-9	116	115	124	119.6	123.5	25.3	
R-3			56.1	56.8	47.1	23.4	
P-7	8.4	9.2	16.7	23.0	24.4	13.2	
P-6	87	81	91.5	95.1	96.6	50.0	
P-4	73	68	83.2	82.3	86.3	60.4	
P-2	141	139	153.7	147.0	153.2	87.7	
R-4			14537	15668	17010	11470	
P-13	172	197	211	249.9	219.5	134	
R-5			129.6	109.6	136.4	42.3	

ATTACHMENT 15

SULFATE — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1	✓		1629	2201	2300	221.7 ?	<0.5 MG/L WILL NOT SUPPORT AQUATIC GROWTH.
R-2	✓		152.5	97.1	120	94.2	
R-2A	✓		22.1	25.9	25.9	21.9	
P-12	✓		75.6	107.0	120	121.8	
P-11	65	56	39.2		125	80.0	
D-17	✓	20	14.0	12.2	18.4	16.4	
D-16	93	87	71.2	79.8	66.0	68.5	
P-10	38	38	27.3	38.7	38.0	54.7	
P-9	139	137	120.6	134.9	155	58.6	
R-3	✓		24.1	38.3	48.0	31.0	
P-7	42	44	37.4	52.2	58.0	31.0	
P-6	67	64	43.2	62.2	68.8	140	
P-4	39	40	36.2	40.2	41.2	38.9	
P-2	70	70	53.1	77.0	77.0	68.5	
R-4			1776	2258	2400	1770	
P-13	123	147	127	178.5	160	90.2	
R-5	✓		34.8	91.2	100	35.0	

ATTACHMENT 16

ENDRIN — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.0001 *	<.0001 *			* LEVELS ≤ DETECTION LIMITS
R-2			<.0001				
R-2A			<.0001	"			
P-12			<.0001	"			
P-11	.00001		<.0001				
D-17			<.0001	"			
D-16	.00001		<.0001				
P-10	.00008		<.0001	"			
P-9	.00001		<.0001				
R-3			<.0001				
P-7	.00001		<.0001	"			
P-6	.00001		<.0001	"			
P-4	.00001		<.0001	"			
P-2	.00001		<.0001	"			
R-4			<.0001	"			
P-13	.00001		<.0001	"			
R-5			<.0001	"			
							MAX. CONTAMINANT LEVEL = 0.002

ATTACHMENT 17

LINDANE — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.0001 *	<.0001 *			MAX. CONTAMINANT LEVEL = 0.004
R-2			"	"			
R-2A			"	"			
P-12			"	"			
P-11	*		"				* LEVELS AT OR BELOW DETECTION LIMITS
D-17			"	"			
D-16	*		"				
P-10	*		"	"			
P-9	*		"				
R-3			"				
P-7	*		"	"			
P-6	*		"	"			
P-4	*		"	"			
P-2	*		"	"			
R-4			"	"			
P-13	*		"	"			
R-5			"	"			

ATTACHMENT 18

METHOXYCHLOR — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.001 *	<.001 *			MAX. CONTAMINANT LEVEL = 0.1
R-2			"				
R-2A			"	"			
P-12			"	"			
P-11	*		"				* LEVELS ≤ DETECTION LIMITS
D-17			"	"			
D-16	*		"				
P-10	*		"	"			
P-9	*		"				
R-3			"				
P-7	*		"	"			
P-6	*		"	"			
P-4	*		"	"			
P-2	*		"	"			
R-4			"	"			
P-13	*		"	"			
R-5			"	"			

ATTACHMENT 19 TOXAPHENE := MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.001 *	<.001 *			MAXIMUM CONTAMINANT LEVEL = 0.005
R-2			*				
R-2A			*	*			
P-12			*	*			
P-11	*		*				* LEVELS ≤ DETECTION LIMITS
D-17			*	*			
D-16	*		*				
P-10	*		*	*			
P-9	*		*				
R-3			*				
P-7	*		*	*			
P-6	*		*	*			
P-4	*		*	*			
P-2	*		*	*			
R-4			*	*			
P-13	*		*	*			
R-5			*	*			

ATTACHMENT 20

2,4 – D — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.0001 *	<.0001 *			
R-2			"				
R-2A			"	"			
P-12			"	"			
P-11	*		"				* LEVELS ≤ DETECTION LIMITS
D-17			"	"			
D-16	*		"				
P-10	*		"	"			
P-9	*		"				
R-3			"				
P-7	*		"	"			
P-6	*		"	"			
P-4	*		"	"			
P-2	*		"	"			
R-4			"	"			
P-13	*		"	"			
R-5			"	"			
							MAX. CONTAMINANT LEVEL = 0.1

ATTACHMENT 21 2,4,5 – TP SILVEX – MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.0001 *	<.0001 *			
R-2			"				
R-2A			"	"			
P-12			"	"			
P-11	*		"				* LEVELS ≤ DETECTION LIMITS
D-17			"	"			
D-16	*		"				
P-10	*		"	"			
P-9	*		"				
R-3			"				
P-7	*		"	"			
P-6	*		"	"			
P-4	*		"	"			
P-2	*		"	"			
R-4			"	"			
P-13	*		"	"			
R-5			"	"			
							MAX. CONTAMINANT LEVEL = 0.01

ATTACHMENT 22

ATRAZINE — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1							
R-2							
R-2A							
P-12							
P-11							
D-17							
D-16							
P-10							
P-9							
R-3							
P-7				<.003			
P-6							
P-4							
P-2							
R-4							
P-13							
R-5							

ATTACHMENT 23

COPPER LEVELS — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			.09	0.08	0.25	<.05	
R-2			<.06	<0.05	<.05	<.05	
R-2A			<.06	<0.05	<.05	<.05	
P-12			<.05	<0.05	<.05	<.05	
P-11	0.04		<.06		0.38	<.05	
D-17			<.06	<0.05	<.05	<.05	
D-16	0.0		<.06	<0.05	0.1	<.05	
P-10	0.02		0.06	<0.05	<.05	0.05	
P-9	0.02		<0.06	<0.05	0.1	<.05	
R-3			<0.06	<0.05	<.05	0.05	
P-7	0.0		<0.06	<0.05	<0.05	<.05	
P-6	0.02		0.06	<0.05	<.05	0.06	
P-4	0.01		0.06	<0.05	<.05	<.05	
P-2	0.02		0.06	<0.05	<.05	0.20	
R-4			0.09	0.05	0.14	<.05	
P-13	0.0		<0.06	<0.05	<.05	<.05	
R-5			<0.06	<0.05	<.05	<.05	

ATTACHMENT 24

IRON LEVELS — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			1.28	0.53	1.03	2.55	1-2 MG/L LETHAL TO PIKE, TROUT & PERCH AT PH 5.0 TO 6.7
R-2			1.8	0.06	0.06	0.52	
R-2A			.02	3.99	1.26	1.59	
P-12			—	3.83	6.7	3.92	
P-11	5.6		5.12 ~ 0.22 Res		150	0.95	Residual
D-17			1.24	2.70	22.8	6.46	
D-16	5.9		5.9	5.42	30.0	4.18	
P-10	2.2		2.36	0.43	0.19	4.18	
P-9	2.0		8.68	9.70	3.7	1.16	
R-3			31.4	5.18	4.8	5.89	Steel casing (rust)
P-7	3.1		0.52	0.12	0.58	2.04	
P-6	2.5		5.94	0.07	0.05	1.92	
P-4	4.6		7.38	0.32	0.08	0.68	
P-2	4.2		6.58	0.25	0.07	4.98	
R-4			0.24	0.38	0.45	0.60	
P-13	4.6		3.04	0.33	0.02	0.19	
R-5			50.6	1.07	0.38	2.69	Steel Casing

ATTACHMENT 25

MANGANESE — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			.06	0.08	0.08	0.04	15 MG/L - TOLERATED BY TROUT (7 DAYS MAX.)
R-2			.01	0.01	<.01	<.01	
R-2A			<.01	0.05	0.02	0.03	
P-12			—	0.15	0.27	0.06	
P-11	1.9		1.35 + .22 Res		0.10	1.02	Residual .22
D-17	/		0.21	0.57	0.92	0.62	
D-16	0.73		0.11	0.33	1.17	0.15	
P-10	0.14		<0.10	0.01	<.01	0.10	
P-9	0.11		<0.10	0.16	0.11	0.02	
R-3	/		0.10	0.25	0.12	0.19	
P-7	0.20		<0.1	0.02	0.01	0.03	
P-6	0.20		<0.1	0.02	<.01	0.06	
P-4	0.42		<0.1	0.01	0.01	<.01	
P-2	0.40		<0.1	0.03	<.01	0.14	
R-4			<0.1	0.05	0.05	0.04	
P-13	1.3		0.27	1.02	0.51	0.05	
R-5			0.27	0.14	0.10	0.06	

ATTACHMENT 26

ZINC LEVELS — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			<.1	0.05	<0.1	0.34	.01 MG/L LETHAL
R-2			<.1	0.1	<0.1	<0.10	TO YOUNG
R-2A			0.15	0.08	<0.1	<.10	TROUT & OVA
P-12			0.18	0.05	<0.1	<.10	
P-11	0.05		<.10		1.2	<.10	
D-17			0.15	0.05	<0.1	<.15	
D-16	0.01		<.10	<0.05	0.1	<.10	
P-10	0.04		<0.10	<0.05	<0.1	<.10	
P-9	0.03		<0.10	<0.05	<0.1	<.10	
R-3			0.26	<0.05	<0.1	<.10	
P-7	0.03		<0.10	<0.05	<0.1	<.10	
P-6	0.02		<0.10	<0.05	<0.1	<.10	
P-4	0.03		0.22	<0.05	<0.1	<.10	
P-2	0.04		<0.10	<0.05	<0.1	0.20	
R-4			<0.10	<0.05	<0.1	<.10	
P-13	0.04		0.13	0.05	<0.1	<.10	
R-5			0.11	<0.05	<0.1	0.40	

ATTACHMENT 27

COLIFORM — MPN/100 ML

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			230	79	2200	≥ 24000	Phase VI readings high overall – possibly due to heavy rains during 1st day of sampling (surface run off)
R-2			≥ 24,000	< 2	2	350	
R-2A			2.2	< 2	490	8	
P-12			> 16	14	170	≥ 2400	
P-11	9200	9200	> 16 ?	DRY	≥ 24000	≥ 24000	
D-17		46	23	2400	79	≥ 2400	
D-16	790	460	7	< 2	17	≥ 2400	
P-10	1100	17	49	2	63	79	
P-9	≥ 24000	1700	16000	230	9200	1600	
R-3			130	4	49	1600	
P-7	130	< 2	13	< 2	33	920	
P-6	330	2	5	2	< 2	≥ 2400	
P-4	230	3500	79	33	7	920	
P-2	70	49	11	13	8	79	
R-4			27	23	700	≥ 24000	
P-13	790	17	94	9200	79	79	
R-5			49	5	8	1600	
							< 100 MPN/100 ML IS A DESIREABLE LEVEL

ATTACHMENT 28

FECAL COLIFORM — MPN/100 ML

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1			—	33	22	≥24000	
R-2			<2.2		<2	23	
R-2A			—		2	<2	
P-12			<2.2		<2	<2	
P-11		5	<2.2	DRY	<2	13	
D-17		<2	—		<2	<2	
D-16		<2	—		<2	11	
P-10		<2	—		<2	<2	
P-9		<2	—		11	70	
R-3			—		<2	49	
P-7		<2	—		<2	170	
P-6		<2	—		<2	≥2400	
P-4		<2	—		<2	<2	
P-2		<2	—		<2	<2	
R-4			—		13	1700	
P-13		2	—		<2	<2	
R-5			—		<2	350	
							<20 MPN/100 ML IS A DESIREABLE CRITERIA

ATTACHMENT 29

PH

BORING	PHASE I FIELD/LAB	PHASE II FIELD/LAB	PHASE III FIELD/LAB	PHASE IV LAB	PHASE V	PHASE VI	REMARKS
R-1			8.3/8.0	7.4	7.9	7.1	
R-2			6.8/7.5	7.3	7.2	6.8	
R-2A			7.0/7.4	7.4	7.9	7.5	
P-12			7.6/7.6	7.6	7.5	7.3	
P-11	6.7/7.2	6.9/8.1	7.6/7.8		7.5	7.3	
D-17		7.5/8.1	7.3/8.3	7.8	7.8	7.6	
D-16	6.8/7.3	6.8/7.8	6.4/7.7	7.2	7.1	6.2	
P-10	7.3/7.7	6.9/8.1	6.2/7.7	7.5	7.7	7.3	
P-9	7.1/7.4	7.0/8.1	6.1/7.7	7.5	7.3	7.5	
R-3			7.6/7.7	7.6	7.8	7.5	
P-7	7.4/7.8	7.2/8.2	6.0/8.0	7.7	7.6	7.3	
P-6	7.1/7.4	7.0/8.0	6.6/7.5	7.6	7.3	7.2	
P-4	7.0/7.2	6.9/8.0	5.9/8.3	7.2	7.3	7.0	
P-2	7.2/7.6	7.1/8.0	6.7/7.5	7.7	7.4	7.5	
R-4			6.9/7.1	7.9	8.1	6.5	
P-13	7.0/7.8	6.9/8.0	6.7/7.7	7.2	7.6	7.1	
R-5			7.1/7.8	8.0	7.6	7.6	

ATTACHMENT 30

CALCIUM LEVELS — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1				350	319	40.6	CALCIUM IS BENEFICIAL TO HUMANS
R-2				49.0	60	40.6	
R-2A				43.0	38	32.2	
P-12				76.0	69	62.5	
P-11	50				48	46.9	
D-17				52.0	44	39.1	
D-16	55			57.0	53	18.8	
P-10	60			59.0	53	49.2	
P-9	127			121.0	109	28.6	
R-3				62.0	49	28.6	
P-7	47			51.0	45	25.0	
P-6	73			70	64	46.9	
P-4	55			52.5	53	46.9	
P-2	84			87.0	76.6	46.1	
R-4				361	353	187.5	
P-13	98			110	95	65.0	
R-5				69.4	—	39.1	

ATTACHMENT 31

MAGNESIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1				1040	906	113	
R-2				33	47	34.7	
R-2A				29	28	26.6	
P-12				53.5	50	46.8	
P-11	26				38	31.5	
D-17				30	30	29.1	
D-16	25			30	30	14.0	
P-10	29			31	31.5	32.3	
P-9	50			54	66	12.5	
R-3				23	22	13.8	
P-7	17			21	24	11.9	
P-6	29			31	32.5	26.6	
P-4	19			20	21	18.1	
P-2	27			29	29	20.6	
R-4				1100	—	680	
P-13	33			43	43	30.3	
R-5				29	30	13.8	

ATTACHMENT 32

BICARBONATE LEVELS — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1				109	119	29	
R-2				187	242	183	
R-2A				190	194	190	
P-12				234	243	202	
P-11	185	237			219	152	
D-17		249		219	216	217	
D-16	180	185		160	166	24.5	
P-10	270	273		219	226	240	
P-9	425	476		414	396	126	
R-3				214	190	121	
P-7	250	266		220	235	110	
P-6	285	274		220	229	131	
P-4	190	190		138	158	118	
P-2	270	259		208	207	167	
R-4				108	110	92	
P-13	305	314		268	266	235	
R-5				234	258	127	

ATTACHMENT 33

POTASSIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1				260	260	36	
R-2				1.5	1.3	1.0	
R-2A				0.5	1.7	1.0	
P-12				1.5	1.8	2.0	
P-11					1.8	2.0	
D-17				1.0	1.5	2.0	
D-16				1.5	1.5	0.5	
P-10				1.5	1.2	1.0	
P-9				1.5	1.7	1.0	
R-3				1.0	0.9	1.0	
P-7				1.5	1.0	1.0	
P-6				1.5	1.2	2.0	
P-4				1.5	0.7	1.0	
P-2				1.5	1.4	1.5	
R-4				1300	280	224	
P-13				0.5	0.7	1.0	
R-5				3.0	2.3	2.0	

ATTACHMENT 34

FLUORIDE — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1				0.9	1.1	0.3	* LEVEL BETWEEN 63.9° & 70.6° F
R-2				0.2	0.16	0.2	
R-2A				0.2	0.2	0.2	
P-12				0.2	0.2	0.2	
P-11		0.11		DRY	0.2	0.2	
D-17		0.19		0.2	0.2	0.1	
D-16		0.16		0.2	0.2	0.1	
P-10		0.21		0.2	0.2	0.3	
P-9		0.22		0.2	0.3	0.4	
R-3				0.2	0.2	0.3	
P-7		0.60		0.6	0.6	0.6	
P-6		0.22		0.2	0.3	0.3	
P-4		0.16		0.2	0.2	0.2	
P-2		0.20		0.2	0.2	0.3	
R-4				0.9	1.1	0.9	
P-13		0.22		0.2	0.3	0.2	
R-5				0.2	0.2	0.4	

ATTACHMENT 35

SODIUM — MG/L

BORING	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI	REMARKS
R-1				8200	8400	990	
R-2				56	71	59	
R-2A				43	43	43	
P-12				50	50	50	
P-11	43				48	43	
D-17				37	37	37	
D-16	51			55	57	58	
P-10	53			50	50	49	
P-9	107			100	96	48	
R-3				35	36	29	
P-7	44			46	50	31	
P-6	64			62	64	49	
P-4	46			47	47	42	
P-2	86			89	94	79	
R-4				8700	8500	6560	
P-13	134			160	154	113	
R-5				75	74	35